First Impact studies

V. Previtali

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ADT for collimation studies

- The transverse feedback system for the LHC comprises a total of four damper systems, one per beam and plane. Each system is equipped with four kickers, whose plates are 1.5 m long with an aperture of d0 = 52 mm. The maximum voltage difference is V = 10.5 kV . The maximum kick for each kicker can be calculated as:

$$k_M = \frac{V \cdot L}{d} \cdot \frac{1}{E}$$

  where L is the plate length and E is the particle energy.

- With the specified characteristics, the maximum kick de- livered by the whole system per turn goes from 2.7 μrad at 450 GeV to about 0.2 μrad at the nominal 7 TeV energy.

- To achieve a reproducible blow-up of the beam a broad- band excitation is used: with this method the output spectrum is sufficiently flat with frequency and represents a white spectrum.

Routine description

- The code performs a normalized phase space analysis that utilizes the horizontal twiss functions and phase advances to map the passage of each particle at the four ADT kickers and at the horizontal primary collimator in IP7 (TCP).

	FLAT TOP All energies		SQUEEZED 4 TeV		SQUEEZED 7 TeV	
element name	β_x [m]	μ_x [2π]	β_x [m]	μ_x [2π]	β_x [m]	μ_x [2π]
ADT D	257.4	24.156	257.4	24.300	257.4	24.303
ADT C	255.0	24.157	255.0	24.301	255.0	24.304
ADT B	251.2	24.159	251.2	24.302	251.2	24.305
ADT A	248.9	24.160	248.9	24.303	248.9	24.306
TCP	149.3	47.178	149.3	47.337	149.3	47.340
Q_x	64.28		64.31		64.31	
Q_s	61.8		26.187		21.4	

5 cases:

1. Flat top 450 GeV
2. Flat top 4 TeV
3. Flat top 7 TeV
4. Squeezed optics 4 TeV
5. Squeezed optics 7 TeV

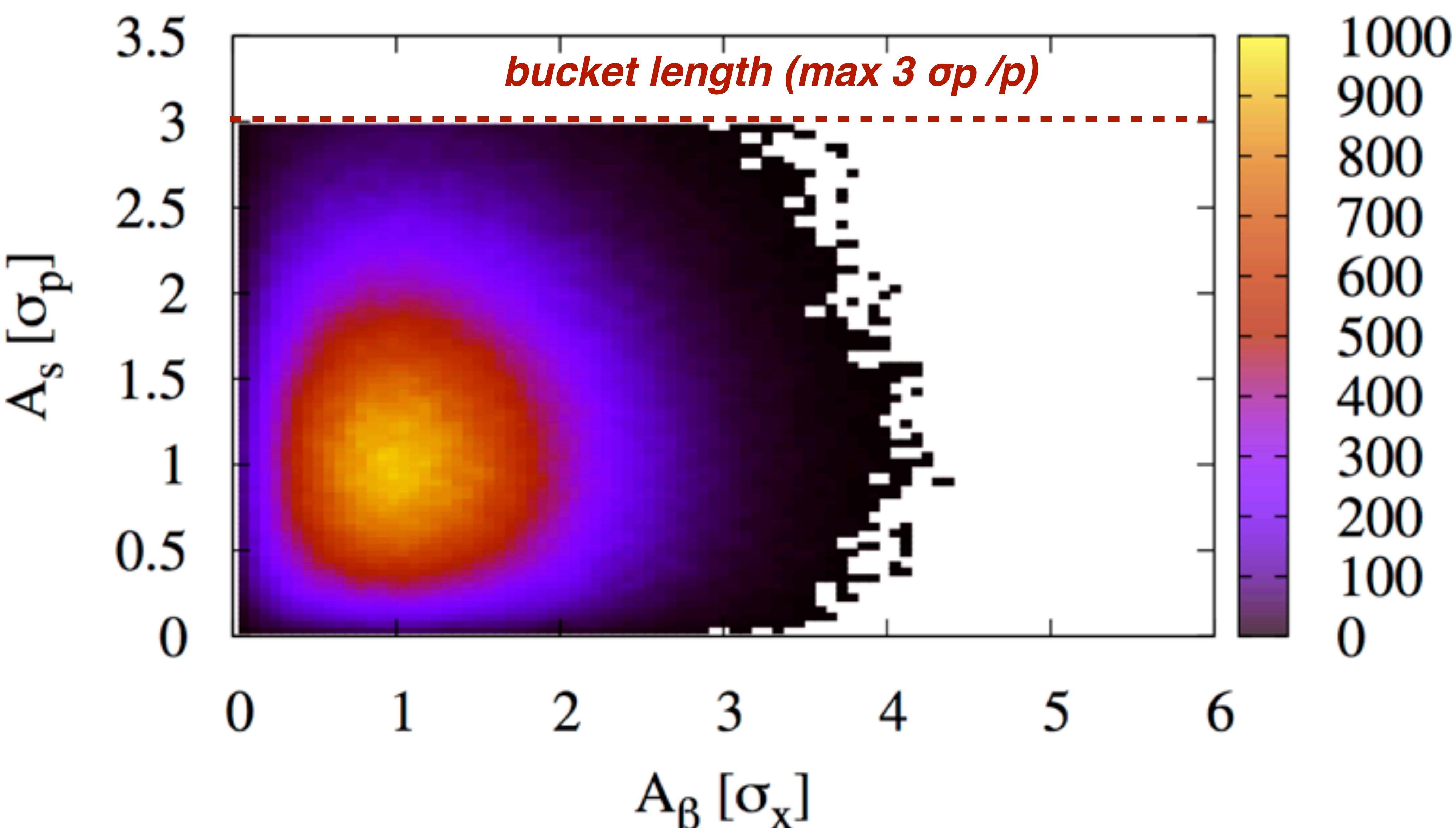
- For each passage from the damper kickers, each particle receives a random kick in the range [–g kM : g kM] where kM is the maximum deliverable kick and g is the amplifier gain which, in our simulations, can be set in the range [0 : 1]

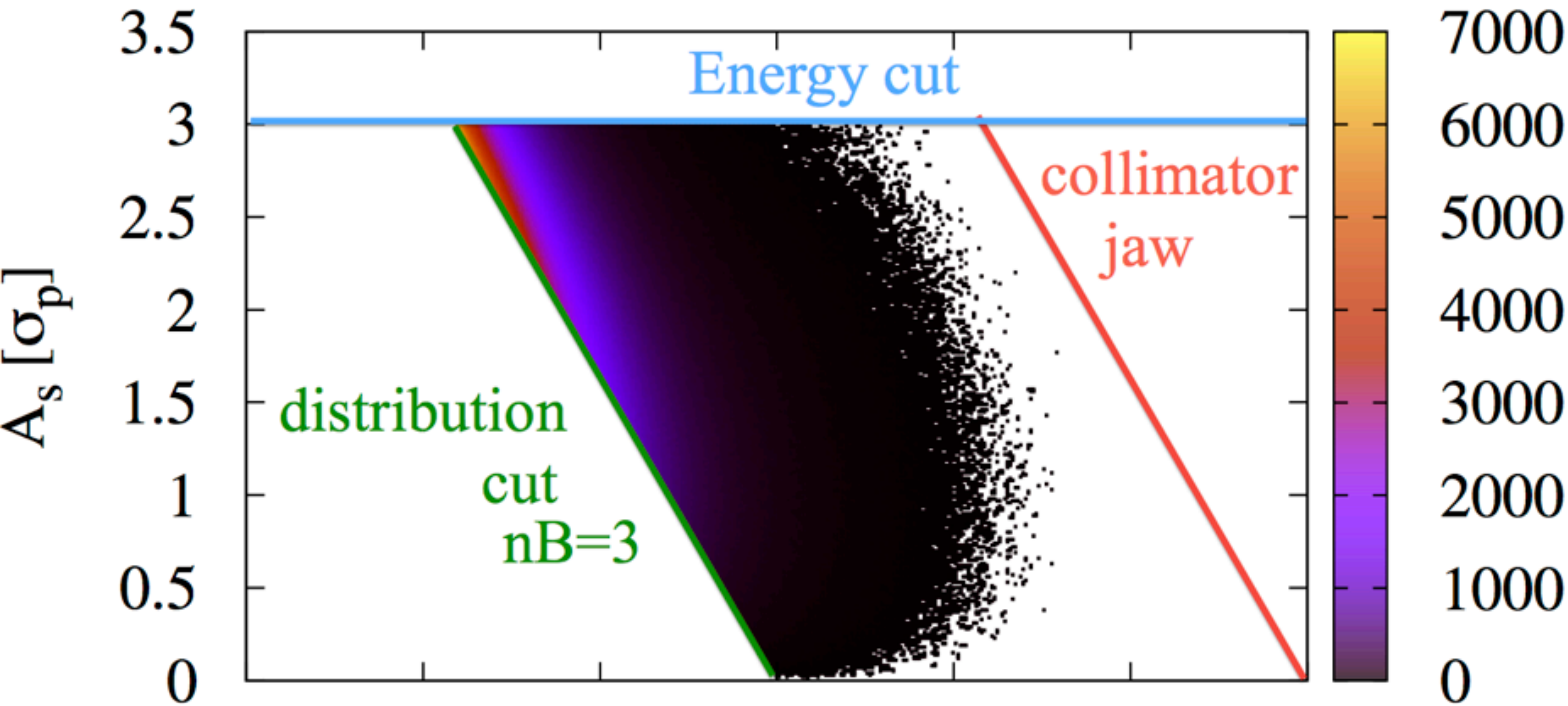
- When the particle reaches the collimator position, its physical transverse position and angle are calculated; if the transverse position is larger than the collimator aperture, then particle is removed from the simulation and its coordinates saved in the output file. The TCP is therefore treated as a black absorber.

	β_x [m]	α_x [-]	D_x [m]	D'_x [-]
FLAT TOP	149.3	2.041	0.32	-0.0047
SQUEEZED 4 TeV	149.3	2.041	0.61	-0.0092
SQUEEZED 7 TeV	149.3	2.040	0.62	-0.0093

Halo generation

- The initial particle distribution is assumed to be a double gaussian both in the normalized betatron and in the normalized synchrotron space. A normalized transverse emittance of 3.5 μm rad and a typical $\sigma p / p = 3.6 \; 10^{-4}$ are assumed.

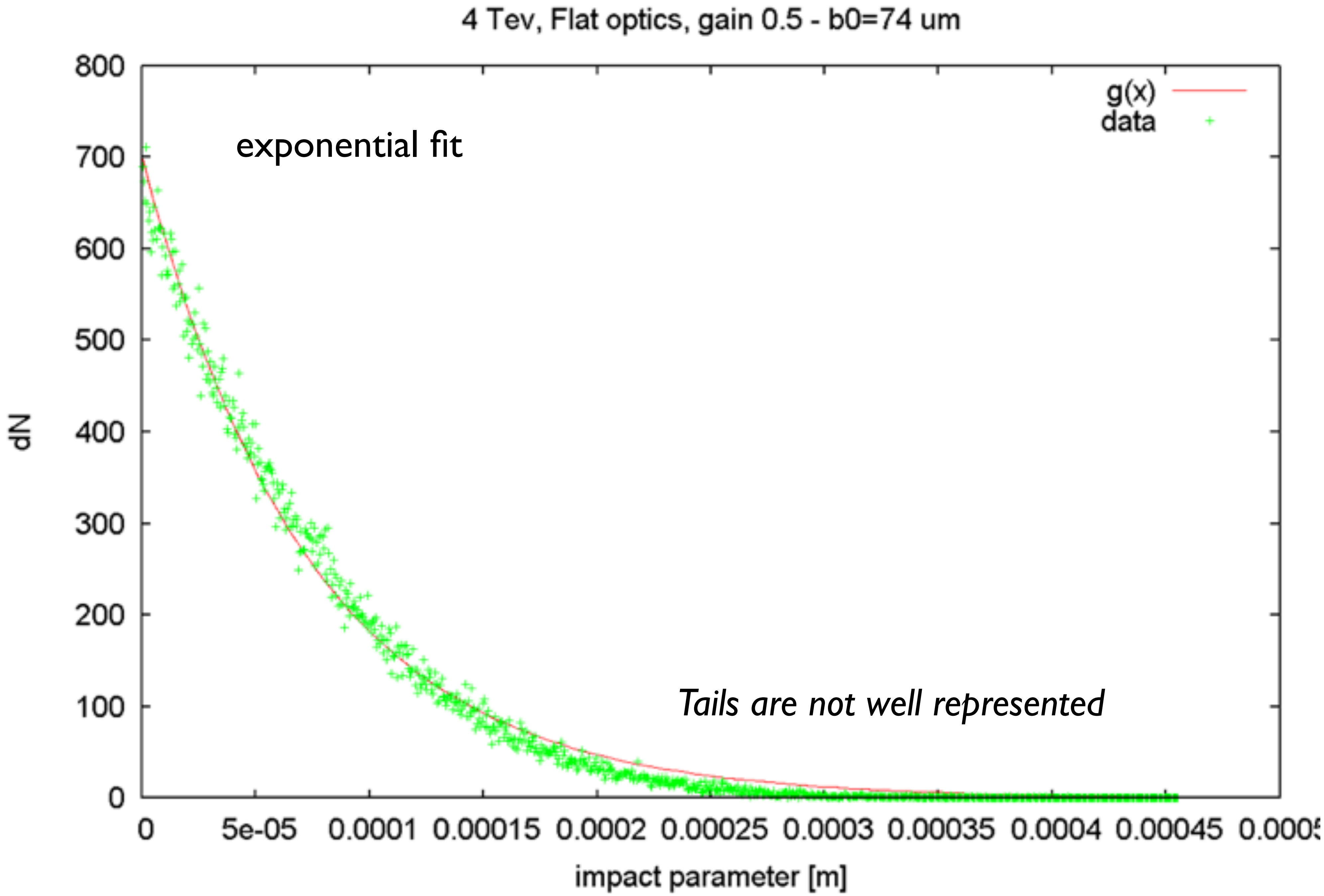


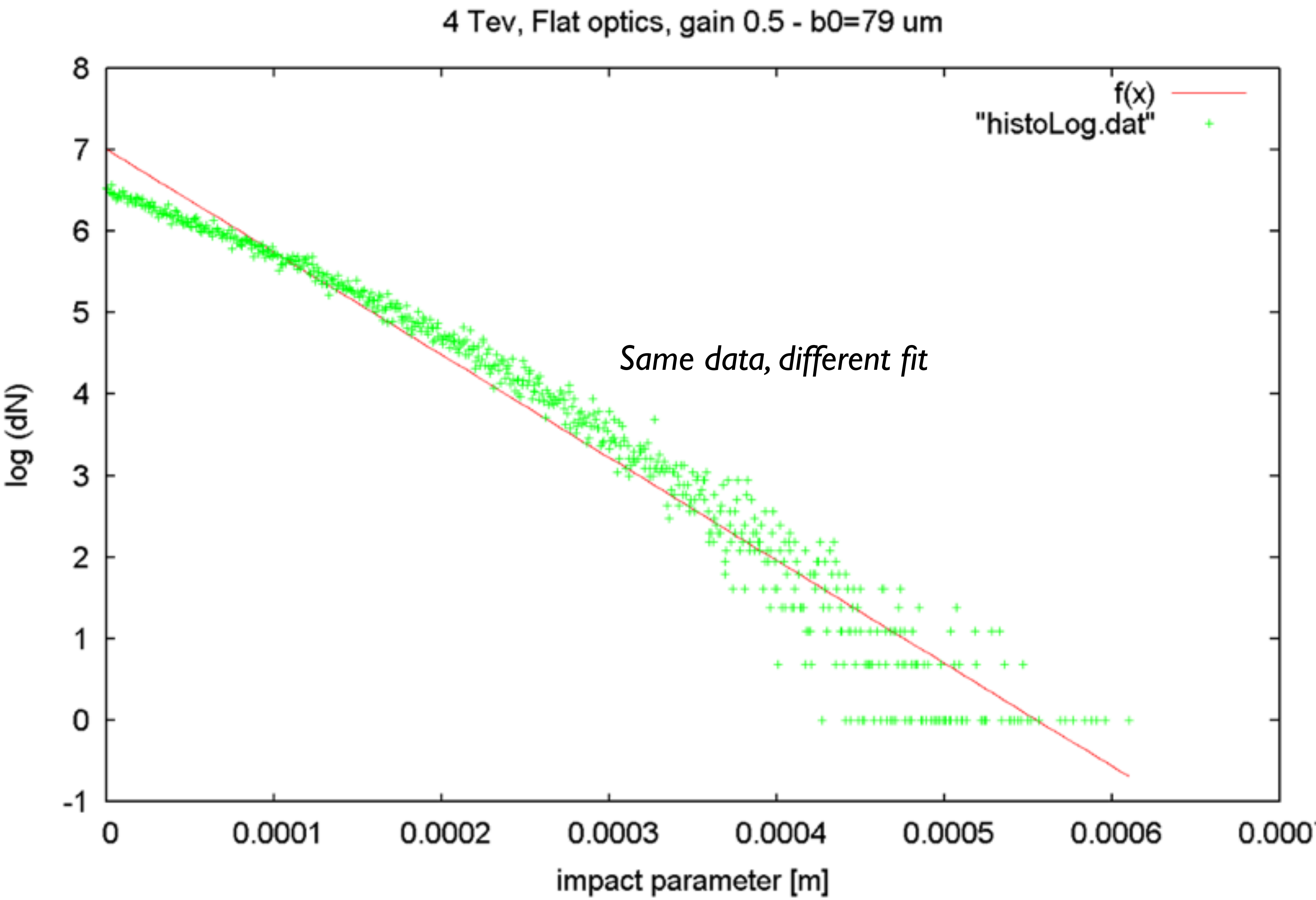


Three cuts can be applied to the initial particle distribution:

- **Energy cut:** a maximum momentum acceptance of 3σp/p is considered.
- **Collimator cut:** since non-linearities are not included in the code, the primary collimator jaws describe a line in the same space: no particles over the collimator aperture are generated.
- **Beam core cut:** for some cases, it might be useful to disregard the beam core and study only halo particle; a cut can be applied so that only the region adjacent to the collimator edge in the space Aβ , As is generated. In the example shown in Fig. 1 (top), a distribution cut has been applied such that no on-momentum particles over betatron amplitude nB = 3σx are generated

First Results




4 Tev, Flat optics, gain 0.5 - b0=79 um
f(x)
"histoLog.dat"
log (dN)
impact parameter [m]
8
7
6
5
4
3
2
1
0
-1
0
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
Same data, different fit

Work in progress

- Most cases simulated
- Data still to be analyzed and understood
- Compare with realistic parameters used during collimation MDs (need further interactions with experts)
- The plan is to write a note about these studies